

REMARKS

Filed concurrently herewith is a Request for a Two-Month Extension of Time which extends the shortened statutory period for response to July 28, 2003. Accordingly, Applicant respectfully submits that this response is being timely filed.

The Official Action dated February 28, 2003 has been received and its contents carefully noted. In view thereof, claims 11-37 have been cancelled in favor of new claims 38-59 in order to better define that which Applicants' regard as the invention. Accordingly, claims 38-59 are presently pending in the instant application.

Referring now to the Official Action, particularly page 2 thereof, Applicants note the Examiner's Amendment to the title which has been carried out by the Examiner. While Applicants agree with the new language for the title, it is noted that new claim 38 does not recite the limitation of hydrogen. Consequently, it is respectfully submitted that the title be as suggested by the Examiner except for the phrase "With Hydrogen". Should the Examiner disagree with Applicants' position with respect thereto, he is hereby invited to contact the undersigned to discuss this matter in detail.

Referring now to page 3 of the Office Action, claims 11-18, 20-22, 24, 25, 27-29, 31-33, 35 and 36 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Japanese Patent Publication No. 10261770A issued to Satoru et al. in view of Sun et al. This rejection is respectfully traversed in that the combination proposed by the Examiner neither discloses nor remotely suggests that which is presently set forth by Applicants' claimed invention.

As can be seen from the foregoing amendments, Applicants' claimed invention now recites a method for fabricating a semiconductor device comprising the steps of forming a lower electrode on a substrate; annealing of the lower electrode in a reducing atmosphere that contains impurity atoms; forming a capacitative insulating film on the lower electrode after the previous

step and forming an upper electrode on the capacitive insulating film, wherein the impurity atoms are introduced into the lower electrode in step (b). In rejecting Applicants' claimed invention, the Examiner notes that Satoru et al. fails to disclose that the electrode is annealed in a reducing atmosphere and relies on the teachings of Sun et al. as disclosing APT, RU, IR thin film capacitor which includes the electrode annealed with hydrogen. In this regard, it is respectfully submitted that the combination proposed by the Examiner would not lead one of ordinary skill in the art to the present invention.

First, as recognized by the Examiner, Satoru et al. does not disclose that the impurity atoms for reducing are introduced into the lower electrode before forming a capacitive insulating film. On the other hand, Sun et al. discloses H₂ damage on page 10.3.2 left column, lines 4-10. The H₂ damage, however, is effected by forming gas (N₂/H₂ = 95/5) after forming a capacitor. The experimental result shown in Figure 6 of the Sun et al. reference are produced by the experiment explained on page 10.3.1, in which the H₂ is investigated as a result of annealing in forming gas (Ns/H₂ = 95/5) after forming the lower electrode BST and the upper electrode sequentially. Accordingly, the Sun et al. reference clearly fails to suggest that hydrogen exists in the lower electrode before the forming of the BST. Accordingly, it is respectfully submitted that neither Satoru et al. or Sun et al. when taken alone or in combination, suggest that the impurity atoms are introduced into the lower electrode before forming the capacitive insulating film. Even in combining the references in the manner suggested by the Examiner, the configuration of the present invention is not achieved.

That is, in accordance with the present invention, the lower electrode is annealed in a reducing atmosphere containing the impurity atoms, and thereby the impurity atoms for reducing are introduced into the lower electrode. Thereafter, even when the lower electrode is heated in an oxidizing atmosphere, an oxidization of the lower electrode can be partially suppressed. As a

result, it is possible to prevent the deformation of the lower electrode. Accordingly, in accordance with the present invention, the impurity atoms for reducing exist in the lower electrode before forming the capacitative insulating film. Accordingly, in that neither the teachings of Satoru et al. nor that of Sun et al. disclose or remotely suggest such features, it is respectfully submitted that Applicants' claimed invention as set forth in claims 11-18, 20-22, 24, 25, 27-29, 31-33, 35 and 36 clearly distinguish over the prior art of record and are in proper condition for allowance.

With reference now to page 4 of the Office Action, claims 11-18, 22, 23, 24, 25, 27-29, 31-33, 35 and 36 have been rejected under 35 U.S.C. §102(b) as being anticipated by Tsunemine et al. This rejection is respectfully traversed in that the Tsunemine et al. reference neither discloses nor remotely suggests that which is presently set forth by Applicants' claimed invention.

As noted hereinabove, in accordance with Applicants' claimed invention, the lower electrode is annealed in a reducing atmosphere containing the impurity atoms and thereby the impurity atoms for reducing are introduced into the lower electrode. Thereinafter, even when the lower electrode is heated in an oxidizing the atmosphere, an oxidation of the lower electrode can be partially suppressed. As a result, deformation of the lower electrode in accordance with Applicants' claimed invention is prevented.

With respect to the teachings of Tsunemine et al., this reference teaches the use of oxygen and not impurity atoms. Consequently, the impurity atoms for reducing are not introduced into the lower electrode as is the case with the present invention. Moreover, there can be found no description that hydrogen exists in the lower electrode before forming the capacitive insulating film in Tsunemine et al. While the Examiner points out that Tsunemine et al. discloses that the lower electrode is annealed with hydrogen before forming the capacitor

dielectric, Fig. 6 of the Tsunemine et al. reference shows only a change in the leakage current of unintergrated flat BST capacitors after a 100% H₂/30 minute annealing at 400°C after hydrogen annealing, and does not disclose the lower electrode in a hydrogen atmosphere before forming the capacitive insulating film.

Additionally, Fig. 6 of the Tsunemine et al. graphically illustrates an effect of conducting hydrogen annealing after forming a capacitor, namely, an upper electrode in a passivation film. Clearly Tsunemine et al. does not have any need for considering the leakage current by hydrogen annealing before forming the capacitive insulating film. Even if the leakage current by annealing in hydrogen before forming the capacitive insulting film where evaluated, in connection with the application set forth by Tsunemine et al. it would be meaningless. Accordingly, it is respectfully submitted that Fig. 6 of Tsunemine et al. is not based on the results of annealing in hydrogen before forming a capacitive insulating film as suggested by the Examiner. Accordingly, it is respectfully submitted that Applicants' claimed invention as set forth in claims 11-18, 22, 23, 24, 25, 27-29, 31-33, 35 and 36 clearly distinguishes over the teachings of Tsunemine et al. and are in proper condition for allowance.

Further with reference to page 4 of the Office Action, claims 19, 23, 26, 33, 34 and 37 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Tsunemine et al. in view of Sun et al. This rejection is traversed in that the combination proposed by the Examiner neither discloses nor remotely suggests that which is presently set forth by Applicants' claimed invention.

Initially, it is noted on page 5 of the Official Action that the Examiner relies on the teachings of Andricacos et al. in rejecting the aforementioned claims, however, this reference is not included in the rejection. Accordingly, should the Examiner maintain his rejection in this regard, it is respectfully requested that such rejection be clarified.

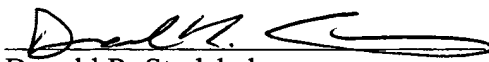
As noted hereinabove, Tsunemine et al. clearly fails to disclose that which is presently set forth by Applicants' claimed invention. Moreover, neither the patent to Sun et al. nor that of Andricacos et al. would overcome the aforementioned shortcomings associated with the teachings of Tsunemine et al.

Again, as discussed hereinabove, Sun et al. discloses H₂ damage, however, the H₂ damage is effected by forming gas (N₂/H₂=95/5) after forming a capacitor. Accordingly, Sun et al. does not suggest that hydrogen exists in the lower electrode before forming BST. Accordingly, it is respectfully submitted that the combination proposed by the Examiner neither discloses nor remotely suggests that the impurity atoms are introduced into the lower electrode before forming the capacitive insulating film, even if the references were combined, the configuration of the present invention is not achieved.

Therefore, in view of the foregoing it is respectfully requested that the rejections of record be reconsidered and withdrawn by the Examiner, that newly presented claims 38-59 be allowed and that the application be passed to issue.

Should the Examiner believe a conference would be of benefit in expediting the prosecution of the instant application, he is hereby invited to telephone counsel to arrange such a conference.

Respectfully submitted,


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